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ABSTRACT

Described is the kindergarten through eighth-grade science program of the Montgomery County Public Schools, Rockville, Maryland. This program places emphasis on biological science and physical science. Involved are activities selected from several sources, which emphasize the processes of science, the nature of science, and the substance of science. Emphasis is given to an activity-centered classroom, where the children learn through their own experiences with materials and investigations selected and designed to take advantage of their natural curiosity. The K-8 program is described with a listing of substantive topics, sources of materials and activities, and a short statement encorporating instructional objectives. (DS)

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Program of Studies

SCIENCE
K-8

MONTGOMERY COUNTY PUBLIC SCHOOLS
Rockville, Maryland

SPRING 1979

SE 031 745

PROGRAM OF STUDIES

SCIENCE, K-8

Department of Instructional Planning and Development
Montgomery County Public Schools
Rockville, Maryland

Spring 1979

SEP 2 1980

The Goals of Education

Adopted by the Board of Education — February 12, 1973

The goals of education for the Montgomery County Public Schools are set forth in this statement of public policy to guide the school system in developing, implementing, and improving educational programs for its students. This statement outlines those goals considered by the citizens of the county as most important for the education of their children in public schools and for which the citizens will hold the school system responsible and accountable.

The school system has the primary responsibility for some of these goals. For others, it shares that responsibility with the home and other community institutions.

The extent to which these goals can be realized will depend upon the endorsement by and continuing commitment of the school system staff, students, parents, and the community. With broad endorsement and wide support, the Montgomery County Public Schools will continue its development to serve its students and community in the most effective way possible.

Education is a process that encompasses the total experiences of each individual throughout a lifetime of formal and informal learning. The school program, as a keystone in this process, should provide opportunities and encouragement for students to acquire knowledge, to explore ideas, to ask questions, and to seek answers that will lead to sound and useful conclusions.

The probability of success motivates students to learn. Each school must create a program and maintain a climate in which every student has opportunities for success. Each individual is unique, and the school shall encourage that uniqueness. The school should help the student understand his [/her] values and the values of others.

The school program, while developing the skills of learning, should be based on the study of broad human concerns, flexible enough to deal with changing concerns and at the same time related to the needs, interests, and concerns of each student. The program should offer opportunities for decision-making. It should help the student develop the capacity to learn throughout his [/her] lifetime, to respond to and understand other human beings, and to accept full responsibility for the results of his [/her] actions.

Therefore, the Montgomery County Public Schools dedicates itself to provide the opportunity, encouragement, and guidance to make it possible for every child to attain the following goals of education:

ACADEMIC SKILLS

The fundamental responsibility of the school is to develop programs that enable each child to acquire those skills basic to all learning. The achievement of all other goals depends upon the success of the school in ensuring that each student, according to his [/her] own abilities, attain the following basic skills:

- **Reading:** The ability to read and comprehend written material and relate it to other knowledge
- **Composition:** The ability to write with precision, clarity, and acceptable usage, whether to inform, inspire, or persuade
- **Listening and Speaking:** The ability to listen attentively and with understanding and to speak with confidence and effectiveness, whether from written material or extemporaneously
- **Mathematics:** The ability to perform computations, to solve common problems of mathematics and logic, and to understand the structure of mathematics so it can be a useful tool in daily living
- **Study:** The development of basic study skills so that he [/she] may acquire knowledge efficiently
- **The Arts:** The development of some of the basic disciplines and skills in the performing and creative arts to be used throughout his [/her] life for communication, expression, and enjoyment
- **Observation:** The ability to identify and differentiate elements of the world around him [/her] as they are useful in personal, academic, and artistic pursuits

PHYSICAL DEVELOPMENT

Each person matures physically at a different rate and possesses differing capabilities. The school has the obligation to help each student:

- understand the biological functioning of his [/her] body
- make the best both of physical talents and limitations
- develop good health habits, skills, and interests to maintain his [/her] body in optimum condition throughout his [/her] lifetime

INTELLECTUAL DEVELOPMENT

In addition to acquiring academic skills, each individual should develop his [/her] intellectual capabilities to the fullest extent possible. Therefore, the school will encourage each pupil:

- to think creatively
- to reason logically
- to apply knowledge usefully
- to deal with abstract concepts
- to solve problems

THE INDIVIDUAL AND SOCIETY

Every person must learn to live in a society. The school must help each student develop an understanding of [people] and of how the individual depends upon others and they on him [/her]. This requires that each student gain:

- knowledge of himself [/herself] and the characteristics, needs, and desires he [/she] shares with others
- sensitivity to others and their ideas, and the ability to act responsibly in various situations
- the ability to function productively as a member of a group
- familiarity with the legal, moral, ethical, and cultural heritages of his [/her] and other societies
- knowledge of the various political systems and philosophies of the world

SCIENTIFIC UNDERSTANDING

[We] must exist in the natural world. The school must help each student understand nature's impact on [us] and [our] impact on nature. This requires that each student gain:

- knowledge of natural phenomena and their effect on [people]
- understanding of scientific advances and their part in modern technology
- understanding of the scientific method
- appreciation of the ways in which the application of scientific principles can improve the quality of life while preserving the natural order

AESTHETIC EXPRESSION

[We], to realize [our] full potential, must be able to sense and appreciate beauty in the world around [us], whether created by nature or by [people]. The school must help each student gain:

- knowledge of the nature of the creative performing arts
- experience with a wide variety of art forms
- a perspective for developing his [/her] own aesthetic criteria and tastes
- understanding of the contribution of the arts to human communication

CAREER DEVELOPMENT

Productive and satisfying work enriches [our lives]; and with increasing leisure time, many people will use various occupational skills for avocational purposes as well. The school must help each student gain:

- knowledge and appreciation of the wide variety and interrelationships of occupations in modern society
- opportunities to explore potential occupations in relation to personal aptitudes and interests, unrestricted by stereotypes of sex, race, or socio-economic level
- the knowledge, skills, and abilities that enable him [/her] to secure satisfying employment, embark upon further training and education in a chosen career field, and adapt occupational talents to changing job demands and opportunities

COMMITMENTS

The Board of Education and the staff of the Montgomery County Public Schools must create and maintain an educational environment that promotes the attainment of these goals by all students. Toward this end, therefore, the public schools make the following commitments to the citizens of Montgomery County:

- ***To attract and retain the most qualified and best trained staff possible through dynamic programs of recruitment, supervision, and continuing in-service training and staff development opportunities***
- ***To develop and implement a comprehensive and flexible instructional program to achieve the aforementioned goals and to provide the facilities, materials, and equipment needed to enhance the effectiveness of the program***
- ***To evaluate the effectiveness of the instructional program continuously, and regularly report the findings to students, parents, staff, and the community***
- ***To adopt new and different approaches when it is determined that they will contribute more effectively to the fulfillment of the goals***
- ***To encourage a continuing dialogue with the entire community, making every effort to communicate needs and achievements, and to be responsive to the needs and aspirations of the school community***
- ***To utilize facilities and staff, in cooperation with other agencies, in the development of preschool, community school, and adult education programs that will meet the continuing educational needs of all citizens***
- ***To provide an accountability procedure for informing county citizens of the objectives and costs of their school system and of reporting periodically on the educational investments made with their tax dollars***

SCIENCE, GRADES K-8

POINT OF VIEW

The Montgomery County Public Schools has as one of its Goals of Education* that each school provide the opportunity, encouragement, and guidance for each student to attain scientific understanding. This goal states:

> [People] must exist in the natural world. The school must help each student understand nature's impact on [people and their] impact on nature. This requires that each student gain:
>
> - knowledge of natural phenomena and their effect on [people]
> - understanding of scientific advances and their part in modern technology
> - understanding of the scientific method
> - appreciation of the ways in which the application of scientific principles can improve the quality of life while preserving the natural order

The MCPS science program supports this commitment.

Science concerns a human enterprise which seeks to organize a system of general laws to account for the phenomena observed in the physical or material world. Much of the character of science is contained in the ways in which apparently factual or hypothetical evidence is sought and brought to bear on these organizational problems. The special nature of science is exemplified by attempts through observation, experiment, and analysis to reduce to a minimum number of consistent generalizations society's increasing understanding of natural phenomena.

The inventory of scientific information currently being discovered and cataloged is making it difficult for science specialists to know all that is being done in their own narrowing fields of study. It is impossible to know what content being taught today will be of most use to our present school population in future years; but it is clear that scientific literacy will continue to be extremely important to our young people, now and as they grow older. Science can flourish best in a cultural and social environment in which the nature of the scientific enterprise is reasonably well understood.

Understanding of the substantive elements of science may be developed in three broad categories:

1. **The data of science:** the body of recorded facts, concepts, principles, and generalizations which permit an orderly description of what informed people believe to be true of the natural world. The data of science may be organized into a number of arbitrary divisions for study and reference, the number and character of the divisions depending upon the needs and purposes of the organizers. For the purposes of general education K-12, it is convenient to arrange this material into the following conventional and simplified divisions: (a) matter; (b) energy; (c) physical interaction; (d) living things; (e) biological interdependencies; and (f) the changing universe.

2. **The processes of science:** the set of typical assumptions and practices which people have used to discover, assess, synthesize, predict, and catalog the data of science. These processes require perceptions and skills in operating with such items as the nature of evidence and hypothesis; probability and prediction; observation, experiment, and conclusion; measurement, error, and control; test, rejection, and modification; definition and delimitation; and accuracy in language. It is convenient to arrange these elements as (a) identifying and analyzing problems; (b) designing and conducting experimental procedures for the solution of problems; (c) interpreting results of experiments; (d) projecting and predicting next steps; and (e) reporting and organizing results.

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*Adopted February 12, 1973 by the Board of Education of Montgomery County, Maryland

3. **The applications of science:** all the ways by which the data and processes of science have been utilized by people and societies to influence their relationships with the natural world and with each other. Science has been instrumental in the (a) modification of living standards and economic development; (b) improvement of personal and community health; (c) establishment of cultural values; (d) adjustment of social and political problems; and (e) exploitation, conservation, and restoration of the environment.

A program for general education in science must include opportunity for selected experiences with all of the above. The balance and emphasis accorded to each should vary in respect to the apparent requirements of individual learners and in general with the experience and maturity of all students. In recent years, many professional scientists and science educators have recommended increasing emphasis on the *processes* of science while decreasing stated emphasis on the *data* of science and very often omitting almost all reference to the *utility* of science. This intellectual bias favoring "pure science" has resulted in the development of a series of courses which are satisfying to many students but which are rejected by others as not being relevant to contemporary societal problems. "Science" is often alleged, improperly, to be responsible for many of the conditions which disturb individuals and societies at this time. Such misunderstanding and lack of objectivity, while not universal, indicates that science education in the past has not been entirely effective. More recently, science program designs and classroom activities have included more emphasis on the applications of science, particularly as they affect the relationships among science, technology, and society.

For these reasons, the following general objectives for the K-12 science program are considered to be necessary for the general education of students and for the development of a scientifically literate society. The science program should provide for:

Understanding of systematically selected scientific concepts, principles, and generalizations and competence in applying those which are important to the realization of personal goals and to intellectual, technological, and social advancement

Experiences with numerous activities designed to develop appreciation for the skills in logical, critical, and creative thinking, particularly through familiarity with the processes of science

Experiences in an atmosphere of integrity in science activities which encourage and allow students to react to and interpret stimuli with objectivity

Experiences in science activities which allow students to develop creative and emotionally satisfying feelings regarding themselves, their society, and their environment

Experiences throughout the science program which enable students to assess their interests and abilities for the pursuit of a career in science or technology

Differentiated performance objectives to meet the needs of students of varying ability levels and interests

Interfaces with other subject areas and programs including environmental, outdoor, and consumer education; drug abuse; health science; basic skills of reading, writing, and mathematics; and career education

GENERAL INFORMATION

The K-8 science program places emphasis on biological science and physical science.

The children are involved in activities selected from several sources that emphasize the processes of science, the nature of science, and the substance of science.

Emphasis is given to an activity-centered classroom. Children learn through their own experiences with materials and investigations selected and designed to take advantage of their natural curiosity. Confronted with such experiences, children acquire concepts by recreating them. As children grow and mature, they need guidance and encouragement in using many procedures of scientific inquiry. Self-discovery is essential to science education, and children use their curiosity and imagination as they take part in activities involving many sensory experiences.

Teachers are encouraged to explore and use materials and activities that support the objectives described. The content or substance of science materials selected by the teacher should provide children with meaningful problem-solving situations.

Instruction in science is usually conducted by the class teacher as part of a large block of time in the school day, averaging 125 minutes per week in Grades K-2 and 225 minutes per week in Grades 3-8. The program includes units of work and activities from large content areas of science, as noted previously in the Point of View: (a) matter; (b) energy; (c) physical interactions; (d) living things; (e) biological interdependencies; and (f) the changing universe.

DESCRIPTION OF PROGRAM — GRADES K-8

Science — Grades K-2 3 years

Children discover new meanings through their sensory experiences; seeing, hearing, tasting, smelling, listening, and talking help them interpret events in their environment. Practice in manipulating, observing, selecting, and ordering encourages children to seek solutions to individual questions and problems. As children grow and mature, they are encouraged to observe carefully, to test their ideas by experimentation, and to check their explanations. To increase powers of observation and skills involved in experimentation, children are confronted with problem-solving activities that help them interpret physical and biological phenomena. Children are involved in their immediate outdoor environment and make increased use of the school grounds and nearby communities.

Upon completion of Grade 2, the child should be able to:

1. Observe objects, living things, and happenings in his/her environment
2. Wonder about the environment and ask questions
3. Investigate by manipulating materials, talking, listening, thinking, and reading
4. Make guesses about the happenings in his/her environment
5. Identify properties and attributes of materials to group or categorize data
6. Discover similarities and differences among materials, substances, and their properties
7. Learn to accept evidence about events in making conclusions
8. Practice skills and identify terms effective in finding relationships in a variety of materials, objects, and organisms
9. Search for more information about material objects and their interaction
10. Discuss and record his/her science observations and experiences
11. Build a science vocabulary through manipulative activities involving verbal and nonverbal communication

12. Develop an awareness of the variety among things and some relationships between things in his/her environment
13. Identify time/space and material objects in an ordered sequence and recognize interrelationship of organisms to their environment
14. Relate to his/her environment through group activities and interrelationships that recognize each child as an individual with both responsibilities and privileges in the group
15. Observe the presence of a variety of living and nonliving parts of his/her own ecosystem
16. Develop basic skills in observing, manipulating, organizing, and grouping
17. Develop awareness of things in his/her environment that can be explained through use of the senses and on the basis of the orderliness of nature
18. Indicate an awareness of scientists and their achievements through dramatization of stories and role-playing

These program instructional objectives should be a direct product of the interaction of teachers and students as they work with the substantive topics and selected science materials. A list of substantive topics and sources of materials and activities follows for Science, Grades K-2.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
	MCPS Montgomery County Public Schools CIS Concepts in Science ESS Elemenary Science Study EIS Experiences in Science *SCIS Science Curriculum Improvement Study
Force and Motion	(MCPS-Ramps)
Muscular force; gravitational force; frictional force	(CIS-Yellow, Level K)
Magnetic force	
Motion on an inclined plane	
The lever, a simple machine	
Properties of Matter	(MCPS-Grouping)
Weight, a property	(CIS-Yellow, Level K)
Differing substance and texture, shape, color, odor, taste	(ESS-Attribute Games and Problems) (EIS-Groups)
Variety of sounds from different objects	(SCIS-Material Objects)
Floating and nonfloating objects	
Environmental Differences	(CIS-Yellow, Level K)
Water plants and land plants	(SCIS-Organisms)
Structures of seed plants	
Varied structure in animals, gills or lungs	

*The original SCIS program entered the public domain in 1978 and is now available as follows: SCIS (original), SCIIS, and SCIS II. Information about the three programs is available through the science office and the current list of approved elementary textbooks.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Needs and Processes of Living Things	(MCPS-Pets and Other Animals)
Variations in structure and function in seed plants	(CIS-Yellow, Level K)
Life functions of plants	(EIS-Life Histories)
Growth and reproduction in animal life	(SCIS-Organisms)
Forms of Energy	(MCPS-Magnets)
Mechanical, electrical, and chemical energy	(MCPS-Sound)
Gravitational pull	(CIS-Blue, Level 1)
Friction and use of energy	(ESS-Spinning Tables)
Work, the rate and amount of energy	(EIS-Hot and Cold)
	(EIS-Light and Shadow)
Forms of Matter	(CIS-Blue, Level 1)
Solids, liquids, and gases (rocks, water, ice, air, etc.)	(ESS-Attribute Games and Problems)
	(ESS-Drops, Streams, and Containers)
Seasonal changes	(ESS-Pattern Blocks)
Physical changes in states of matter, temperature	(ESS-Sand)
	(SCIS-Material Objects)
Effect of Environment on Living Things	(CIS-Blue, Level 1)
Water, food, air — needs of plants and animals	(ESS-Growing Seeds)
Plants and animals, growth and structure	(EIS-Plants in Spring)
Balanced aquarium	(SCIS-Organisms)
Survival, the environment (light, heat, etc.)	
Reproduction	(CIS-Blue, Level 1)
Resemblance of offspring to parents	(EIS-Plants in Spring)
Different species, large and small (life cycle)	(EIS-Young Animals)
Growing plants (radish, bean, corn, etc.)	(SCIS-Organisms)
Dogs, cats, birds	
Forms of Life	(MCPS-Seeds)
Size, structure, growth differences	(CIS-Blue, Level 1)
Variety and diversity of form in living things	(SCIS-Organisms)
Early forms of life	
Earth and Daily Changes	(CIS-Blue, Level 1)
Weather (clouds, snow, sunshine, etc.)	(ESS-Light and Shadow)
Night and day	(EIS-Earth and Sun)
Temperature and changes in state of matter	(EIS-Weather)
Rotation of earth	
Energy Changes	(CIS-Red, Level 2)
Sources of energy, fuels	(ESS-Mirror Cards)
Electric energy, generators, and batteries	(EIS-Batteries)
Energy converters, plants	(EIS-Magnets)
Forms of energy interchangeable	(SCIS-Interaction and Systems)

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Matter and Motion	(CIS-Red, Level 2)
Evaporation and diffusion	(ESS-Primary Balancing)
Solutions	(EIS-Air) (EIS-Balances)
Changes in temperature, motion of molecules	(SCIS-Interaction and Systems)
Transfer of heat and sound	
Steam and work	
Environmental Conditions for Life	(MCPS-Plants)
Sunlight and survival of life forms	(CIS-Red, Level 2)
Environments (fresh water, desert, woodland, etc.)	(EIS-Living Things)
Function of plant parts	(SCIS-Life Cycles)
Conditions of life for butterflies, spiders, earthworms, oysters, starfish	
Life Cycles	(CIS-Red, Level 2)
Seed plants, beans and conifers	(ESS-Brine Shrimp)
Plants, parts and functions	(ESS-Butterflies)
Plant classification	(ESS-Life of Beans and Peas)
Butterflies, earthworms, oysters, and cows	(SCIS-Life Cycles)
Extinct Life	(CIS-Red, Level 2)
Some life forms extinct	(EIS-Life Histories)
Diversity of environmnts	
Kinds of plants today	
Coal age life forms: reptiles, insects, etc.	
Movement of Earth and Moon	(CIS-Red, Level 2)
Phases of moon	(ESS-Where is the Moon?)
Bodies in space; planets, moon, stars, meteors	(SCIS-Interaction and Systems)
Rotation, revolution of earth	
Changes and motion	

Science — Grades 3 and 4 2 years

In Grades 3 and 4, children observe and experiment and continue to interpret everyday happenings. They are encouraged to seek solutions to questions and problems dealing with increasingly complex phenomena.

They make measurements, record data, and share information within groups. Children make greater use of simple models, instruments, and other science materials. They observe the interaction of various plants and animals, and they consider the interdependence of individuals and population. Children consider the physical conditions that determine an organism's environment. They deal more with science as inquiry and gain facility in interpretation of events in the environment. The children are asked to describe the changes they observe with increased precision. They deal with spatial relationships of moving and stationary objects and get a greater understanding of large concepts such as diversity and motion of molecules.

Upon completion of Grade 4, the student should be able to:

1. Express his/her own ideas about personal observations
2. Recognize a problem
3. Investigate by manipulating materials and recording the results on tables, diagrams, graphs, and charts
4. Select the hypothesis which offers the best explanation to a problem
5. Begin to select data which are pertinent to the problem
6. Relate previous experience to new situations
7. Make choices and draw conclusions from evidence obtained
8. Organize his/her scientific findings using such devices as lists, pictures, diagrams, models, reports, summaries, exhibits, collections, and stories
9. Improve skills in reorganizing ideas in the light of new information
10. Communicate descriptions of activities and their results
11. Use with understanding science words appropriate to his/her level of maturity
12. Evaluate his/her efforts and continue to strive for improvement by setting new standards
13. Recognize variety, time, space, adaptation, balance, and interrelationships
14. Develop a positive self-concept and see himself/herself as a worthy and acceptable individual who has worthwhile contributions to make to the group
15. Increase his/her awareness of the interrelationship of plants, animals, and the physical environment
16. Demonstrate that science is an orderly process involving cause and effect relationships perceivable through investigation by human beings
17. See that while change is continuous, there are cycles and patterns that give a degree of stability that insures predictability of events important in people's lives
18. Identify some of the ideas and discoveries of men and women in science who have made significant contributions to our body of knowledge

These program instructional objectives should be a direct product of the interaction of teachers and students as they work with the substantive topics and selected science materials. A list of substantive topics and sources of materials and activities follows for Science, Grades 3 and 4.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
	MCPS Montgomery County Public Schools CIS Concepts in Science ESS Elemenary Science Study EIS Experiences in Science *SCIS Science Curriculum Improvement Study
Radiant Energy	(CIS-Green, Level 3)
Sun's energy: life, growth, motion, change, work	(EIS-Heat)
Electricity, electromagnets	(EIS-Motion)
Energy conversion from one form to another (light to heat, electric to heat)	(EIS-Sound)
Green plants and energy	(SCIS-Subsystems and Variables)

*The original SCIS program entered the public domain in 1978 and is now available as follows: SCIS (original), SCIIS, and SCIS II. Information about the three programs is available through the science office and the current list of approved elementary textbooks.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Structure of Matter	(CIS-Green, Level 3)
Elements and compounds	(ESS-Changes)
Physical change and chemical change	(ESS-Colored Solutions)
Substances made of molecules	(ESS-Match and Measure)
	(ESS-Mobiles)
	(ESS-Mystery Powders)
	(ESS-Printing)
	(EIS-Chemical Change)
	(SCIS-Subsystems and Variables)
Environments and Related Living Forms	(MCPS-Habitats)
Environments change; succession	(CIS-Green, Level 3)
Soil as an environment	(EIS-Plant and Animal Responses)
Special environments and their living inhabitants	(SCIS-Populations)
Animals of the past	
Classification of Living Things	(CIS-Green, Level 3)
Common structure in related living things	(ESS-Brine Shrimp)
Life activities	(ESS-Life of Beans and Peas)
System of classification	(EIS-Life Histories)
Reproduction of plants: structure and function	(SCIS-Populations)
Characteristics in common	
Environmental Changes	(MCPS-School Grounds as a Site for Inquiry)
Constant changes in the environment	(CIS-Green, Level 3)
Adaptation to factors in environment	(SCIS-Populations)
Living things vary in diverse environments	
Solar Systems and Changes	(MCPS-Earth in Space)
Relationship of earth and moon	(CIS-Green, Level 3)
Solar system: bodies' size, distance from sun, seasons, rotation and revolution, etc.	(CIS-Earth, Sun and Seasons)
Sun as chief source of energy	
Energy and Motion	(MPS-Melting Ice)
Heat and sound, nature and production	(CIS-Orange, Level 4)
Molecular motion and physical changes	(ESS-Heating and Cooling)
Evaporation and condensation	(ESS-Ice Cubes)
Expansion and contraction	(ESS-Musical Instrument Recipe Book)
Light, sources and characteristics	(ESS-Whistles and Strings)
	(EIS-Solids, Liquids, Gases)
	(SCIS-Relative Position and Motion)
Chemical Changes	(CIS-Orange, Level 4)
Substances, physical and chemical properties	(ESS-Clay Boats)
Rusting, burning, decay	(ESS-Mystery Powders)
Elements and compounds, interaction and change	(ESS-Sink and Float)
Photosynthesis and oxidation	(EIS-Chemical Change)

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Exchange Between Living Things and Environment	(MCPS-School Grounds as a Site for Inquiry)
Cycles of exchange: oxygen cycle, carbon cycle	(CIS-Orange, Level 4)
Processes of exchange; oxidation, decay	(ESS-Earthworms)
Continuous exchange of matter	(EIS-Adaptations)
	(EIS-Ecology)
	(SCIS-Environments)
Environment and Reproduction	(CIS-Orange, Level 4)
Behavior patterns and life cycles	(ESS-Mosquitoes)
Structured adaptations	(ESS-Animal Activity)
From single cell, growth by cell multiplication	(ESS-Animals in the Classroom)
Continuity of species	(ESS-Eggs and Tadpoles)
	(SCIS-Environments)
Living Things and Environmental Changes	(CIS-Orange, Level 4)
Erosion, weathering, water cycle	(EIS-Geological Processes)
Change in seasons	(SCIS-Environments)
Basic structures and common processes in changing environment	
Celestial Bodies and Motion	(CIS-Orange, Level 4)
Moon and comet motions	(SCIS-Relative Position and Motion)
Meteors	
Predictable motions and pathways	

Grades 5 and 6

In the upper elementary grades, students are more mature; and they have developed a set of skills in observing, measuring, and recording data. A continued emphasis is placed on confrontation with problem-solving activities. Investigative procedures are practiced, and increased skills are gained in making interpretations and analyzing data. The exchange of matter and energy between plants and animals and their physical environment is investigated, and students are asked to deal with the concept of scientific models. They make hypotheses to assist in making interpretations of physical phenomena of the earth and the universe. They learn to identify variables, relate matter and energy to electrical phenomena, interpret factors in the environment, and see the electrical nature of all matter. Students practice putting things in order in such a way that they can provide more meaningful interpretations of their world.

Upon completion of Grade 6, the student should be able to:

1. Observe for the purpose of making inferences
2. Recognize the mechanics involved in problem solving
3. Investigate by organizing data collecting and by using data in solving problems
4. Formulate observations into statements of hypotheses
5. Differentiate between reliable and less reliable resources for information, and question sources
6. Identify sets of conditions and recognize that these lead to specific inferences

7. Withhold judgment until he/she considers all available evidence
8. Acquire scientific information and concepts, and organize them into meaningful generalizations
9. Recognize as logical the sequence in events such as cause and effect
10. Express results of data collected, in graphs, charts, symbolic forms, and mathematical terms
11. Increase his/her science vocabulary and relate this vocabulary to new situations
12. Reorganize his/her ideas in the light of new information
13. Acquire scientific information and begin to make meaningful inferences useful in making generalizations
14. Recognize and acknowledge a job well done, and be aware of feelings of personal satisfaction in personal accomplishments and contributions
15. Recognize that all human activities depend on the state of our physical being and that our lives are determined by conditions in our physical and biological environments
16. Recognize that scientists have made special contributions to the world at large through activities in research and study
17. Demonstrate that science and technology are products of human endeavor and that in turn all people are products of their heredity and the societal environment
18. Describe and evaluate the role of the scientific enterprise during human history

These program instructional objectives should be a direct product of the interaction of teachers and students as they work with the substantive topics and selected science materials. A list of substantive topics and sources of materials and activities follows for Science, Grades 5 and 6.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
	MCPS Montgomery County Public Schools
	CIS Concepts in Science
	ESS Elemenary Science Study
	EIS Experiences in Science
	*SCIS Science Curriculum Improvement Study
Energy, Force, and Motion	(CIS-Purple, Level 5)
Acceleration of falling objects	(ESS-Kitchen Physics)
Rockets, jet engines	(ESS-Stream Tables)
Satellites and orbital motion	(EIS-Unbalanced Forces)
Pull of gravity, weight, mass	(SCIS-Energy Sources)
Forces, balanced and unbalanced	
Conservation of Matter	(CIS-Purple, Level 5)
Physical and chemical changes: amount of matter unchanged	(ESS-Balloons and Gases)
	(ESS-Colored Solutions)
Compounds according to chemical properties	(ESS-Geo Blocks)
Elements as building blocks	(ESS-Peas and Particles)
Chemical equations	(ESS-Tangrams)
Atoms: electrons, protons, neutrons	(SCIS-Energy Sources)

*The original SCIS program entered the public domain in 1978 and is now available as follows: SCIS (original), SCIIS, and SCIS II. Information about the three programs is available through the science office and the current list of approved elementary textbooks.

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Green Plants and Radiant Energy	(CIS-Purple, Level 5)
Photosynthesis, a process	(ESS-Microgardening)
Green plants (food, fuels, fibers)	(ESS-Starting from Seeds)
The sun: energy source	(EIS-Microscopic Life)
Sources of vitamins	(EIS-Molds)
	(SCIS-Communities)
Cells	(MCPS-Cells)
Unit of structure and function	(CIS-Purple, Level 5)
Structure of cells	(ESS-Bo[illegible]es)
Multicellular organizations	(ESS-Budding Twigs)
From single cell to multicellular organisms	(ESS-Microgardening)
	(ESS-Pond Water)
	(ESS-Small Things)
	(EIS-Microscopic Life)
Living Things and Time	(CIS-Purple, Level 5)
Geologic changes in earth	(EIS-Life Histories)
Adaptation: structure and function	(SCIS-Communities)
Chromosomes: change among living things	
Energy cycles	
Change of living things through time	
Celestial Bodies and Change	(CIS-Purple, Level 5)
Inertia, action and reaction	(ESS-Rocks and Charts)
Origin of solar system	(EIS-Balanced Forces)
Telescopes and spectroscopes	(EIS-Mapping)
Earth's crust, mantle, and core	(EIS-Time)
Motion involves energy	(SCIS-Energy Sources)
Energy Systems	(MCPS-Liquids)
Machines, simple and compound	(CIS-Brown, Level 6)
Efficiency of machines	(ESS-Batteries and Bulbs II)
Electricity: charges, appliances, and devices	(ESS-Kitchen Physics)
Engines: gasoline, steam, jets	(ESS-Pendulums)
Sum of energy and matter constant	(EIS-Color)
	(EIS-Electricity)
	(EIS-Light)
	(SCIS-Models: Electric and Magnetic)
Matter and Energy in Nuclear Reactions	(MCPS-Liquids)
Changes in matter involve energy.	(CIS-Brown, Level 6)
Matter in universe basically the same	(ESS-Gases and Airs)
Structure and characteristics of atoms	(ESS-Senior Balancing)
Electric charges attract and repel.	(ESS-Water Flow)
	(SCIS-Models: Electric and Magnetic)

SUBSTANTIVE TOPICS	SOURCES OF MATERIALS AND ACTIVITIES
Adaptations of Living Things	(MCPS-Pond Study)
Structure and function in particular environments	(MCPS-School Grounds as a Site for Inquiry)
Continuity of life; heredity	(CIS-Brown, Level 6)
Man and Environment	(ESS-Behavior of Mealworms)
Mutations; dominant and recessive traits	(ESS-Crayfish)
	(ESS-Mapping)
	(ESS-Mosquitoes)
	(ESS-Tracks)
	(EIS-Life Processes of Plants)
	(SCIS-Ecosystems)
Genetics and Characteristics	(CIS-Brown, Level 6)
Changes in genetic code	(EIS-Continuity of Life)
Plant and animal breeding	
Evolutionary changes, the horse	
Disease and defense against	
Genetics and Change	(CIS-Brown, Level 6)
Changes in structure of living things	
Dominance, recessiveness, blending	
Man makes changes by control.	
Radiant Energy of Stars	(CIS-Brown, Level 6)
Continuous interaction of matter and energy	(ESS-Daytime Astronomy)
Classification of stars	(EIS-The Universe)
Nuclear reactions; fission	
Origin of the elements	

Description of Courses — Grades 7-8

General Science — Grade 7
3501 1 year

General Science (Grade 7), sometimes called "Life Science," emphasizes the relationship of people to their environment. The substance and level is, in general, compatible with several current textbooks. Topics in this course include:

The basis of life — matter in living and nonliving things; energy and living things; matter cycles; cell structure and function

The organization of life — organization of individual organisms; respiration; digestion; transportation; circulation; elimination; irritability

The continuation of the species — reproduction, variation, and heredity

The balance of life — environmental relationships and the effect of people on the environment

Living a longer, healthier life — forms and causes of disease; ways in which diseases are spread; body defenses against disease; and disease prevention

Drugs and drug abuse — alcohol, tobacco, and controlled dangerous substances

Upon completion of General Science — Grade 7, the student should be able to:

- describe the relationship between matter and energy as related to living things
- identify the basic cell structures and functions common to all living things
- identify the various levels of organization of living things including cells, tissues, organs, systems, and organisms
- describe the various structures and processes utilized by living organisms to accomplish the function of respiration
- describe the various structures and processes utilized by living organisms to accomplish the function of digestion
- describe the various structures and processes utilized by living organisms to accomplish the function of transport
- describe the various structures and processes utilized by living organisms to accomplish the function of excretion
- describe the structure and processes utilized by living organisms to regulate and coordinate their body functions
- differentiate between the major aspects of sexual and asexual reproduction
- recognize the basic cellular and molecular components and processes which govern heredity
- recognize the various ecological factors which affect the balance of life and how people have influenced these factors
- differentiate between drugs that are classified as stimulants, depressants, hallucinogens, and volatile chemicals
- identify the physical and mental effects of drugs upon the body
- identify the social influences that affect drug abuse
- identify methods of disease control, causal agents of disease, and kinds of immunity

General Science — Grade 8
3502 1 year

General Science (Grade 8) contains an organized study of selected problems from earth and physical sciences, divided between the two semesters. Units include the Nature of Matter; Energy; Electricity and Magnetism; the Nature of the Earth and Changes in Its Surface; and the Relation of the Earth to Other Celestial Bodies. Available texts for use at this level typically contain selections of unit material which differ widely from one text to another and from the course of study. Teachers use these texts to insure that representative coverage is achieved. The text and teacher's guide produced by the Earth Sciences Curriculum Projects (ESCP) are approved for use at this level and are used by more than half of the eighth grade science teachers, often with some modification. The equipment and supply kits developed for use with ESCP are available in most schools and may be used also with alternate texts. Topics to be studied include:

The earth's origin; lithosphere; types of rock; weathering and erosion; soil; earth movements; common ores; fuels

The tools of the astonomer; characteristics of stars, galaxies, the universe, the solar system; problems of space travel

Matter — states, physical combinations, properties, changes; theories of atomic structure; classes of chemicals

Energy — forms and sources, heat, radiation, magnetism, sound, and electricity

Upon completion of General Science — Grade 8, the student should be able to:

- identify agents of weathering and erosion and relate these agents to the formation and development of land forms
- identify properties of minerals and rocks and use such properties to classify these into categories or groups
- identify internal forces at work within the earth and their effects on surface features
- identify the properties, features, and movements of the hydrosphere
- identify the methods of interpreting earth history
- identify the instruments and methods used to investigate celestial bodies
- compare theories and evidence about the origin of the solar system
- predict astronomical events based on patterns of motion within the solar system
- measure accurately the physical properties of matter
- distinguish atoms, elements, compounds, and mixtures when given a diagram or description
- relate physical and chemical changes to the molecular theory of matter
- identify relationships between energy and earth cycles
- identify the characteristics and sources of different forms of energy
- describe energy transformations as they relate to energy demands of man
- identify relationships between force, motion, and work
- calculate and compare the efficiency and mechanical advantage of simple and compound machines

MCPS INSTRUCTIONAL GUIDES AND RELATED REFERENCES — SCIENCE, GRADES K-8

Kindergarten — *Ramps*, 1967; *Pets and Other Animals*, 1967; *Grouping*, 1967.

Grade 1 — *Sound*, 1967; *Magnets*, 1967; *Seeds*, 1967.

Grade 2 — *Plants*, 1968.

Grade 3 — *Habitats*, 1967; *Earth in Space*, 1967.

Grade 4 — *Melting Ice*, 1967.

Grade 5 — *Cells*, 1967.

Grade 6 — *Liquids*, 1967.

Teaching Science in the Elementary School, Bulletin No. 276, 1975.

Grade 7 — *Drugs and Drug Abuse: Alcohol, Tobacco, and Controlled Dangerous Substances*, Bulletin No. 240, Revised 1971.
Bibliography and Teacher Packet for Drugs and Drug Abuse: Alcohol, Tobacco, and Controlled Dangerous Substances, Bulletin No. 240-A, Revised 1971.

Environmental Education: A Maryland Approach, Maryland State Department of Education, 1974.

Maryland School Science Facility Guidelines, 1977, Maryland State Department of Education and Maryland Interagency Committee on School Construction.

Outdoor Education Program Handbook, 1978-79.

Safety Handbook, July 1971.

School Grounds as a Site for Inquiry, Bulletin No. 234, 1970.

Summary of Contracts (issued annually by the Division of Procurement)
Bid, General and Biological Chemicals
Bid, Microscopes
Bid, Secondary School Science Supplies and Equipment Quote
Purchasing of live, preserved, and miscellaneous biological materials